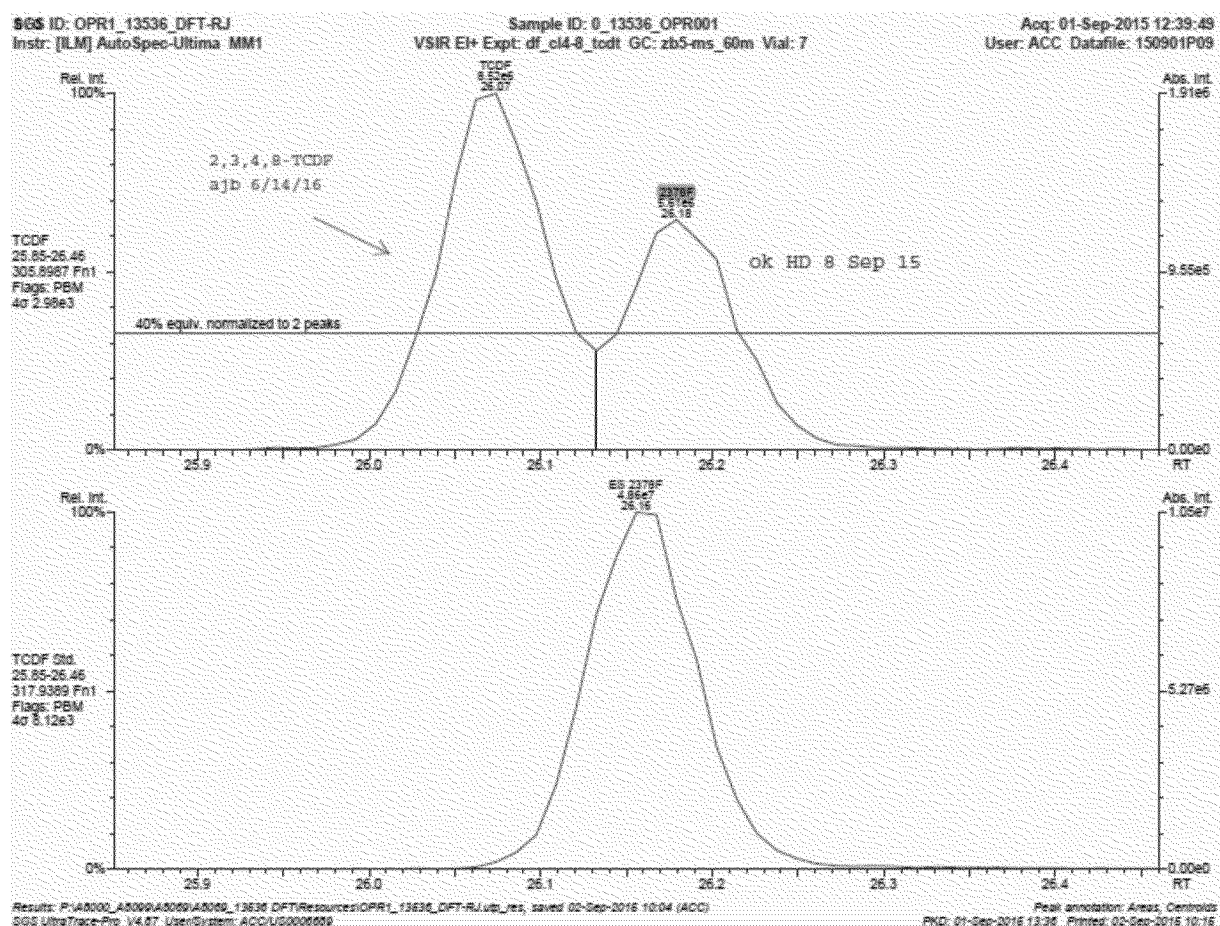


## Quantification of 2,3,7,8-TCDF in the Presence of the Closely Eluting 2,3,4,8-TCDF Congener

The issue of potential interference in the quantification of 2,3,7,8-TCDF has been addressed in EPA methods and supporting literature. Yves Tondue, the founder of Analytical Perspectives (acquired by SGS) discussed this issue in the appended white paper (Analytical Perspectives 2001). Dr. Tondue worked with the EPA Office of Water in the development of PCDD/F Method 1613.

Analyses of Givaudan containment cell samples conducted by SGS in 2009 and 2015 generated 2,3,7,8-TCDF data that passed all quality control requirements to safeguard against co-elution interferences. Figure 1 presents a screenshot from the analysis of a mid-range Ongoing Precision and Recovery (OPR) standard for the analysis of Givaudan's 2015 containment cell samples. Resolution between the 2,3,4,8-TCDF peak on the left and the 2,3,7,8-TCDF peak on the right exceeded the 40% minimum requirement, and was attained for all reported analyses.

**Figure 1.** Graphical display of OPR analysis captured on September 1, 2015 by SGS-Analytical Perspectives for Givaudan containment cell samples.



Quantification of 2,3,7,8-TCDF was generated using the routine integration algorithm of the HP6890 GC / AutoSpec-Ultima mass spectrometer. This algorithm, typical for all GC/MS instruments, is based on the decades-old principal of how to integrate peak areas with

valley-to-valley separation (i.e., less than 100% baseline resolution). A perpendicular is dropped from the valley between peaks to the baseline, followed by separate integration of the peak area on each side of the perpendicular. Resulting concentrations are only equal if the peak height, peak shape, and analytical standard response factors are identical. This occasionally occurs but not frequently, and in any case, successful integration and quantification does not require those characteristics. Reliable quantification is possible when the peaks are adequately resolved to reduce the uncertainty of how overlapping peak areas are distributed (i.e., >40% resolution for these peaks).

The 2,3,7,8-TCDF and 2,3,4,8-TCDF peaks in Figure 1 have a similar shape, are partially overlapped, and use similar but not identical relative response factors for quantification. However, the peaks differ substantially in total area on each side of the perpendicular line. Therefore, the calculated concentrations will also differ substantially.

Quantification of these two TCDF congeners in the 2009 and 2015 Givaudan samples did not require anything other than routine integration by the GC/MS instrument. All results passed internal laboratory QA review and third party data validation by LDC Inc.